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PLANNING AND OPERATING TURNPIKES

by Charles M. Noble

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PLANNING AND OPERATING TURNPIKES

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Introduction

There is little relation between the modern turnpike and the turnpike of the eighteenth century. The latter, more often than not, were strictly private ventures built at a time when highway transportation was motivated with animal power and traffic volumes pitifully low. These ventures, hastened by the development of the canal and railway, were financial failures. The modern turnpike on the other hand was germinated in the automotive era when great volumes of mixed traffic were involved and were constituted as government activities. Generally they have been financed on the revenue bond principle on a self-liquidating basis, with capital raised from private sources repaid solely from tolls and other charges assessed against the users of the facility. The combination of government sponsorship (State), heavy traffic demand and revenue bond has assured success for the projects placed in operation to date.

There must be real traffic, economic and public demand to justify the expense of setting up a turnpike authority and carrying out the studies necessary to establish the financial feasibility of a given project.

Legislation

Of fundamental importance is the drafting of turnpike legislation. The best legal talent should be employed in this task. Present practice sets up the turnpike body as a State agency, performing as essential governmental function and delegates specific and general powers of sufficient breadth to enable it to perform the function quickly and unhindered by outside forces. The form may be either a Commission or an Authority although the latter has attained stature by reason of a long history of favorable court decisions and familiarity of investors with its structure. Usually the act provides that when paid off the facility reverts to the State and becomes an integral part of the State Highway System. A desirable innovation would provide that before being freed of tolls a capital fund be accumulated in sufficient amount when invested in trust to maintain and operate the facility from the proceeds of the interest in perpetuity. This will require a relatively short time since the earnings at that time are at a maximum.

The Act sets up the number of Commissioners, how appointed, length of term, manner of succession and compensation, if any. Usually the Governor of the State is the appointing officer and often Senate (State) approval is stipulated. The first set of Commissioners are usually appointed for unequal terms to avoid expiration falling within the same year and so that

thereafter the terms will be staggered. Often the Chairman of the State Highway Commission serves as an ex-officio member of the turnpike commission.

Other essential features of the Act include:

- (a) A pledge by the turnpike that revenues will be used solely for maintenance, operation, payment of interest and amortization of the bonds. The property is not mortgaged, even in case of default the title to the facility remains with the turnpike. In the case of a strictly revenue bond set-up the faith and credit of the State is specifically not pledged. Indebtedness incurred is not charged against the debt limit of the state.
- (b) Provision for an advance of funds in order to finance preliminary expenses, engineering and traffic reports suitable for negotiating and consummating the sale of bonds to cover the cost of constructing the project. Usually the advance is repaid out of the proceeds of the bonds. The preliminary expenses of the New Jersey Turnpike Authority exceeded \$1,000,000, including the cost of final surveys, design, plans and borings incurred up to the date of bond sale.
- (c) Authority for authorized representatives of the turnpike to enter upon private and public property, without constituting a trespass, for the purpose of making surveys, soundings, test pits and borings, etc.
- (d) Establishes in the turnpike body the right of eminent domain and the authority of immediate possession of property upon the filing of condemnation papers. It is usual to require the turnpike to file a bond or a cash deposit with the court to cover the appraised value of the property.
- (e) Sets up authority for the turnpike to relocate utilities or cause them to be relocated and for the bridging, closing, and/or relocation of streets, highways and railways.
- (f) Establishes the bonds as tax-free securities.
- (g) Provision that the turnpike body may have complete freedom in letting out concessions on the turnpike.
- (h) Establishes the life of the bonds. Some issues have been limited to 30 years, but more recently on expensive projects the bond life has been extended to 35 years, since some projects would not have sufficient "coverage" on a 30 year bond.
- (i) Authorized the Commission to establish appropriate rules and regulations affecting traffic or conduct on the turnpike.

In order to avoid delays, particularly during the construction period when substantial bond interest is accumulating, the turnpike body must be allowed complete freedom of action and decision. Veto or supervisory powers in the hands of other agencies can prove fatal. If the adoption of the turnpike principle is considered necessary in the public interest, the Commissioners entrusted with execution must be clothed with the widest powers and the greatest latitude for discretion.

And, finally, every precaution must be taken to assure the constitutionality of the Act. The laws of each State differ and the Act must be drawn in harmony with the State laws and court decisions. Almost invariably it will be necessary to test the constitutionality of the Act in the Supreme Court of the State before buyers will purchase bonds.

The Preliminary Engineering and Traffic and Revenue Report

After enabling legislation, appointment of the Commissioners, organization and the determination of a project likely of success, it is necessary to take two steps:

- (a) A preliminary engineering survey of the proposed project, feasibility investigation and estimate of cost, followed by a formal report.
- (b) A Traffic and Revenue Report.

The Engineering Report. It has been customary to have the engineering survey and report prepared by a nationally known Consulting Engineering firm with experience in this field and having the confidence of the financial fraternity. On large projects when time is of the essence the authority may employ several firms of engineers and, in addition, a firm of general consultants to review the findings and consolidate the reports of the other consultants into a report to be utilized in the financing. At the outset the turnpike authority and its consulting engineers should agree on the geometric design standards, including the roadway cross-section, right-of-way width and general policy on cross roads and utility relocations. The cost of the highway is closely identified with these features.

First of all, it is necessary to determine the engineering feasibility of the project. Then map and field reconnaissance examination is made in sufficient detail that the routing of the turnpike may be selected from one of several routes studied. In this work, consideration is given to natural travel routes, centers of traffic generation such as population, industry and motor vehicle registration, traffic counts and the economic facts of the region. Consultation with the planning agency of the State and close liaison with the planning division of the State Highway Department are desirable in order that the route selected will serve the people of the State and region most effectively, supplement and complement the State and Interstate Highway System and result in attracting the maximum traffic in the territory. It is also desirable that it function as part of the Interstate System of Highways.

The number and location of traffic Interchanges is an important consideration and careful thought must be given origin and destination of traffic. The condition and suitability of existing connecting routes, traffic congestion, focal points of population and industry, traffic desire lines, not only for long distance travel but also for local movements as well, are all pertinent factors.

The policy concerning concessions should be established by the turnpike authority as to scope, frequency, general design and whether the authority will develop the sites and construct the buildings or have them provided by the concessionaires with recapture by the authority at the end of an amortization period.

The preliminary engineering report should be a comprehensive document suitable for perusal by financial interests with a complete description of the project, the service it will perform, the design standards, Interchanges, concessions, maintenance facilities, toll facilities, construction schedule, estimate of cost, estimate of administration and operating expenses and a review of the traffic and revenue report, including copies of the Estimated Results of Operation and the Amortization Schedule from that report. Suitable illustrations and exhibits should be included to make the project and report thoroughly understandable and complete.

The estimate of cost encompasses all items required to place the highway in full operating condition and includes administration; legal costs; financing costs; repayment of preliminary expenses; interest during

construction (and generally for a year thereafter); engineering; borings; construction, including buildings for maintenance, police, toll booths, administration and concessions, lighting, radio, fencing, landscaping, guard rail, erosion control, traffic aids and safety devices, signs, utility services, maintenance of traffic, utility and railroad relocation and restoration, toll equipment, maintenance equipment, police equipment, uniforms, training for police, toll collection, toll audit and maintenance personnel; real estate, cost of real estate acquisition; and contingencies. After financing, this cost is known as the construction fund.

The Traffic and Revenue Report. Again the services of an experienced consulting engineering firm specializing in traffic and revenue work and having an established reputation in financial circles is sought to conduct the studies and make the report. Upon the accuracy of the report will depend the fate of the project.

The traffic engineers seek out all available information from the Highway Department on traffic counts, origin and destination surveys; and economic, population, industrial, commercial markets, and vehicular registration trends from other State or governmental agencies. In addition, the operating records of ferries and toll bridges in the area are scanned.

With these data, a determination is made concerning the scope and location of additional origin and destination surveys and a traffic desire sampling program. It is customary for the State and local police to assist the on-the-road survey crews in handling traffic and preventing disorder.

In addition, a survey is made of current and planned highway, bridge, ferry and tunnel construction in order that the effect of this construction on the proposed turnpike and prospective traffic and revenues may be evaluated properly.

The completed report contains estimates of the amount of traffic that will patronize the various portions of the turnpike, and assumed toll schedule based on the value of the service; and estimates of the revenues from traffic and concessions. The meat of the report is contained in two schedules, "Estimated Results of Operation" and the "Amortization Schedule".

Preliminary Organization: In the preliminary phases of a turnpike project when the financial feasibility of the project is unknown it is risky to build up a large staff other than that contained in the organizations of the consulting engineers. Consequently, it has been customary to secure the services of a limited number of personnel from the State Highway Department on a loan basis. This small group headed by a Chief Engineer establishes in conjunction with the Consulting Highway Engineer and with concurrence of the Commissioners the characteristics, scope, general routing, design standards and tentative Interchange locations of the proposed turnpike. As an example, the New Jersey Turnpike Authority operated at first with a Chief Engineer and one stenographer, with counsel and a recording secretary on a part time basis to take minutes of Commission meetings. Later, a Director of Public Information and another stenographer were added and this small staff carried on until it became apparent that the project would be self-liquidating. Only then was the staff augmented in anticipation of financing and construction. In addition to the staff, Bond Counsel and a Financial Advisor were engaged.

Financing

The word turnpike connotes financing by the sale of revenue bonds, such bonds to be repaid solely from the revenue earnings of the facility itself. It is necessary to borrow the money in advance of construction when earning power and cost of the project are estimated and there is no history of actual earnings. Thus, risk capital is involved. The tax-free character is the attractive feature of the bonds.

On the other hand, the market is in some degree limited since revenue bonds are purchased by certain investors only. Until the Ohio Turnpike sale, the largest single issue on record was \$220,000,000.

The sale may be handled by negotiation or by public bidding. Each has its advantages.

In the case of a negotiated issue, by shrewd bargaining, terms advantageous to the authority may be secured. It is of benefit to be assured of the exact rate of interest; the amount of discount that will be charged, if any; satisfaction that the best terms possible have been secured concerning date and terms of call for refunding or redeeming the bonds after the project has been under operation and other advantages that will determine the ultimate cost through to the end of the amortization period. For example, the New Jersey Turnpike Authority negotiated a sale with the unique provision that the bonds need be "taken down" only as and when required to pay contractors. This saved the Authority \$11,000,000 in interest and financing costs over the two-year construction period.

The public advertisement and sale method protects the authority against accusations of favoritism or that it made a bad bargain. It has the disadvantage that all the terms of the Bond Resolution or Trust Indenture, including the interest rate, must be worked out in advance with the possibility that the best possible terms were not anticipated and secured although bids presumably take the stated terms into consideration.

In both cases the skill, experience and financial acumen of bond counsel and financial advisor are indispensable.

Because interest starts as soon as the bonds are sold and must be paid during the construction period, it would be advantageous if funds could be made available in sufficient amount to defray the cost of final surveys, designs, preparation of contract drawings, property drawings and right-of-way acquisition. In cases where the total bond issue is sold this will reduce interest cost materially.

Construction

When the financing of a project appears assured, rapid assembly of the engineering organization required to establish final alignment, prepare designs and contract drawings, specifications, materials testing, property maps, supervision and administration of construction is essential. From this point on to completion it is a race against time and bond interest.

Prior to World War II the original Pennsylvania Turnpike assembled its own staff of engineers for both design and construction supervision, mostly drawn from the Highway Department. Materials testing was performed in the State Highway Laboratory. Since the War, the shortage of engineers has made this impractical generally. Therefore, turnpike authorities have turned to private consulting engineering firms of national reputation who are able to assemble quickly adequate organizations of engineers. On some projects the consultant surveys the final alignment, prepares designs, specifications

and contract drawings, but supervision and administration of construction is performed by the owner. In other cases, the consultant designs and supervises construction under the administrative direction of the owner. Usually, private laboratories are engaged to test materials and for shop inspection.

On large projects it is desirable to divide the project into sections and assign a consulting engineer to each section in order to bring to bear a sizeable assemblage of personnel so that plans and the work may be gotten under contract at the earliest possible date. In some cases a separate bridge engineering firm and a separate highway engineering firm are assigned the same section and in some instances this is desirable but it does burden administration and coordination.

Bond Resolutions and Trust Indentures usually require the authority to employ a General Consulting Engineer who acts in the dual capacity of safeguarding the interests of the owner and the bond holder. His duties are generally delineated in those documents.

In addition, it is desirable to designate a firm to develop, under the direction of the owner, design standards both geometric and structural, standards of drainage design, standard details, standardized drawings, lighting, toll system, toll equipment, radio system, guard rail, fencing, signs and traffic safety devices, since all these details are common to all sections. The negotiation and preparation of application permits for crossing over navigable waters is also a suitable assignment for this firm. It is also customary to utilize the form of contract and specifications used by the Highway Department since contractors and material producers are familiar with their provisions. Considerable saving of time is accomplished by developing the State specifications with suitable modifications into a "Standard Contract and Specifications" document for the Turnpike and use supplementary specifications to cover unit bid schedules and the special features of each contract.

Finally, it is necessary to engage an architect for the design of the various buildings required for the Turnpike.

Turnpikes have invariably been constructed by contractors, usually under the competitive bidding system, although in some cases it has proved advantageous to negotiate contracts. Because of the speed at which the work must progress and the disastrous consequences of default, it is desirable that an adequate system of contractor prequalification be adopted. This will not guarantee against default, but it does minimize the danger.

A master blueprint for the conduct of the entire design and construction operation must be drawn up at the start. The entire work, section by section, is subdivided into appropriate contracts. The size of contract and the class of work included depends on the number, size and versatility of available contracting organizations that may be interested in bidding for the work.

The contracts are so arranged on the chart with respect to time that the entire project can be finished on a predetermined date. Contracts must be arranged in proper sequence so the work of contractors will follow in logical order, one after the other. This is particularly true when grading, bridges and paving are in separate contracts. The process is similar to an assembly line.

Weekly reports covering progress of both design and construction will indicate quickly where progress lags and pressure should be brought to bear.

Organization. At the outset of the design period the staff of the authority needs to be enlarged for coordination, progress control, avoidance of delayed decisions, handling financial affairs, legal problems and for properly servicing the organization. An appropriate organization chart for a large project is shown in Figure 1.

Right-of-Way Acquisition

One of the most important activities is the acquisition of right-of-way. Construction cannot start until at least a right-of-entry has been obtained.

Therefore, top priority must be given to completing property maps since appraisal and negotiations cannot start until these maps are in the field.

It is obvious that parcels on which buildings are located should be given first priority since it is not only time consuming to evacuate occupants but also time is required for demolition or moving operations.

After the contractor moves in on the job it is necessary to coordinate real estate acquisition with his schedule of operations so that continuous stretches of right-of-way will be available to him where and when he wants them. Weekly consultation with the contractor as to his plans and needs and a listing of critical parcels will highlight the urgent requirements so that the real estate negotiators will apply pressure at the right places.

All too often heroic measures are necessary to keep acquisition abreast of the construction schedule.

Operation

Planning for operation usually starts six to nine months before the scheduled opening of the project. At the start it is advantageous to establish the operation organization chart, job classifications, salary and wage ranges, number of personnel required in each category and a personnel policy. This will give direction and simplify recruitment. Needless to say, personnel should be utilized from the existing staff to as great a degree as possible. It is also desirable to appoint the Superintendent of Maintenance six or more months before the opening date. The date of purchase of maintenance equipment will depend on the lead time in the uncertain market of today. Lists of equipment are drawn up by the Superintendent of Maintenance and orders placed on specific specifications to assure delivery in time to be utilized in the training of maintenance personnel. The Superintendent also prepares a safety manual to be followed by maintenance personnel, keeping in mind the high speed and density of traffic on turnpikes. The preparation of a servicing manual with greasing schedules for each make and model is a necessity, together with a system for assuring that each piece of equipment is actually serviced in accordance with the schedule.

Well in advance of opening, the vehicle classification system and the toll rates for full length trips for each classification and for each interchange should be established. This will allow time for the printing of toll schedules and the tickets (if a ticket system is used) in ample time for opening day. The selection of the make, type and amount of toll auditing tabulating equipment is an important decision as well as whether the machines will be purchased outright or rented. A Service Contract for maintenance and repair is usually negotiated with the stipulation that new models will replace outmoded machines.

It is also necessary to determine policy on whether the turnpike will have its own police force or employ a unit of the State police as a turnpike detachment.

With these decisions it is now possible to establish routine procedures, purchasing procedure, inventory control, accounting procedures and a cost keeping system in order that the operation of the turnpike will be conducted efficiently, utilizing modern business principles.

Several months in advance, specifications and contracts must be prepared for the letting of contracts for the operation of concessions (fuel, oil,

accessories and food). The terms and conditions of these contracts need to be spelled out in sufficient clarity and detail to avoid misunderstanding during operation. Usually these contracts run for a five year period. It is essential that the best and most efficient service be rendered turnpike patrons, otherwise there will be an adverse effect on toll revenue which is far more significant than the revenue received from concessions.

Two to three months in advance, the police Chief and the Superintendent of Toll Collection are appointed. Both of these officers need to become familiar with the project in every detail and prepare for the training of their organizations. In both cases, operating manuals must be prepared and in the case of toll collection, a mastery of the toll collection system is essential.

Similarly, in advance, arrangements are made with local fire and ambulance companies for service on an at-call basis and territories mapped out. The names, addresses and telephone numbers are listed for use of the police, toll collectors and maintenance. Arrangements are made for towing, wrecking and repair services, usually with reputable private garages adjacent to the interchanges. Territories, rules, regulations and maximum charges are worked out, for here again unsatisfactory service or unreasonable charges will result in patron dissatisfaction and may affect toll revenue adversely.

About two months before opening, employment of toll collection, police, maintenance and toll audit personnel should begin in earnest. Selection of uniform style and contracts for manufacture should precede employment of personnel so that measurements and fittings can be made as rapidly as people are employed. Toll collection and police must, of necessity, be organized on a 24-hour a day, seven day a week basis and in the case of collectors, expected traffic volumes and peak hourly rates must be anticipated in order that sufficient personnel will be trained and available at proper locations. The maintenance organization should include men on night duty or on call in case of emergency. Generally, it is advantageous to employ more men than actually calculated to be needed in order to be ready in case traffic exceeds estimates. Surplus personnel can be quickly weeded out on the basis of comparative merit after the actual work load is demonstrated by operating experience. In order that the organization does not remain over-organized, it is desirable to have a well worked out yardstick giving the reasonable expected daily output per man in each job classification. Scientific job test questionnaires filled out prior to employment will minimize turnover due to misfits and incompatibility of temperament. Nevertheless, turnover may be expected to be high in the initial months of operation in areas having a high level of employment.

Immediately after employment of sufficient numbers, the training period is initiated. The training curricula must be well thought out and competent instructors assigned. In the case of police, maintenance and toll audit, experienced leaders are available and it is usually possible to assemble a strong nucleus of experienced personnel around which to build an organization. In the case of toll collection, however, this is a comparatively new field in so far as turnpikes are concerned. The system, of necessity, differs from a toll facility with but one origin and destination. Therefore, training is not only more important but also more difficult. For this reason alone it is desirable to reduce vehicle classifications to a minimum and arrange the classifications in a manner that will enable collectors to identify them surely at a glance. Thorough drill in the collection manual is an essential and collectors must become proficient in making change rapidly and in counterfeit bill detection. A good collector will collect from approximately 300 vehicles per hour.

Maintenance personnel need training and emphasis must be placed on the

difference between maintaining the ordinary highway and a turnpike. The public expects and is entitled to superior maintenance on a turnpike. Conditions that would be tolerated on a toll-free highway will be bitterly criticised by turnpike patrons. The men need to be indoctrinated with the spirit of giving a high order of service.

A training period on the actual equipment purchased for the turnpike is important, particularly from the standpoint of safety. In addition, instruction in the care, servicing, and handling of equipment pays dividends.

The details of the cost accounting system and the inventory and accountability program should be explained to all maintenance personnel, not only to obtain compliance but also to impress upon them that slip-shop methods and practices will not be tolerated.

Finally, all personnel that will use the radio telephone must be indoctrinated and licensed for radio operation.

At this point, the personnel are ready to operate the completed turnpike project. A suggested organization chart is shown in Figure 2. The scale of the organization will, of course, depend on the scope of the project and the volume of traffic. On small projects, one man may handle several of the functions delineated on the chart.

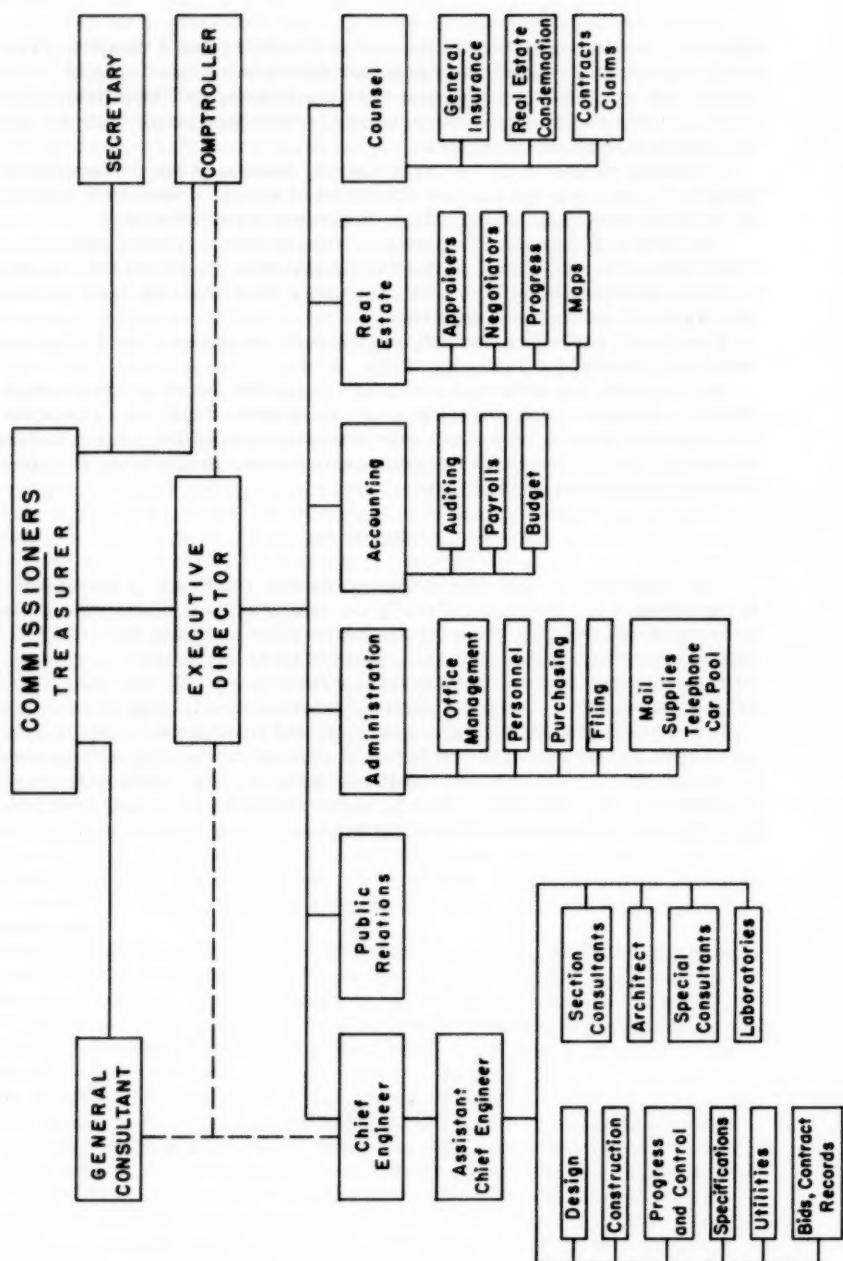
Conclusion

The organization, financing, planning, design, construction and operation of turnpikes is big business. Usually the smallest project undertaken costs upwards of \$40,000,000, while the larger projects approach \$300,000,000 in capital expenditure. Revenues are commensurate with capital cost, as evidenced by receipts on the New Jersey Turnpike, which amounted to \$17,830,000 in 1952. Turnpike earnings increase yearly until amortization.

It is evident, therefore, that engineering and management must be of a high order and that the most modern and efficient business practices need to be utilized in addition to the latest advances in design and construction engineering. The motoring public is discerning and will be satisfied only with the best, not only in engineering but also in maintenance and operation.

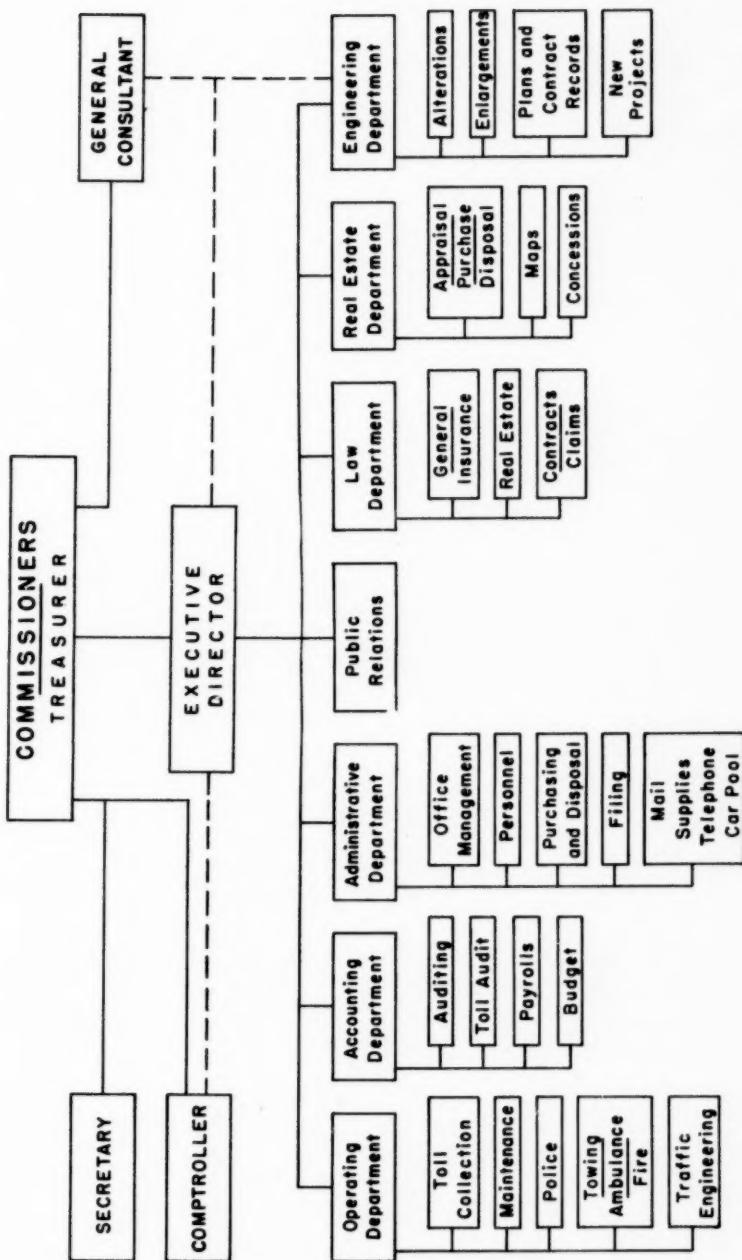
**SUGGESTED ORGANIZATION
DESIGN AND CONSTRUCTION PHASE**

Figure 1



**SUGGESTED ORGANIZATION
OPERATION PHASE**

Figure 2



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